of all the antiperiodics. Excepting in rare cases, the diminution of the spleen occurs immediately upon the administration of the remedy (salt or sulph. quinine), and may frequently be detected within one minute, after which the organ remains stationary until a second dose of the medicament be administered.

Is the chloride of sodium as efficient an antiperiodic as the sulphate of quinine? Are the cures effected by the one as permanent as those effected by the other? The first question can only be answered by those possessing a larger field of observation than the writer. May we not hope for a solution from those of our profession who observe the disease too largely either for comfort or pleasure? In regard to the permanency of the cures, we apprehend there is not much difference, be the medication what it may; for relapses are only too common after the greatest care and most patient attention.

Should the discovery prove as useful and applicable as it promises, the benefit accruing from it will be immense. If it be capable of taking the place of the sulphate of quinine in the majority, or even in one-half the cases of intermittent fever, therapeutics will be largely the gainer.

New York, *March* 26, 1852.

Art. IX.—*New Views concerning the Nature and Cause of Tubercular Deposits.* By Matthew Troy, M. D., of Whiteville, North Carolina.

There is no disease, perhaps, in regard to the pathology of which a greater number of discordant theories have been advanced than that of tubercular consumption. This has arisen as well from its frequency and almost invariable fatality—which would naturally lead the profession to direct their most earnest attention to its investigation, in the hope of discovering for it some certain means of cure or prevention—as from the tangible nature of the product by which it is characterized, and which seems to invite investigation, by promising an easy and ready explanation of its nature and cause. In but few diseases can we lay hold of the *materies morbi* itself. But our being able to do so in the case of consumption seems to have been of but little advantage in leading us to correct views in regard to its true nature and treatment.

It is not my intention to attempt a history of the disease, or to discuss the comparative merits of the several theories that have been advanced in relation to it; but shall merely, previously to offering my own views, give a brief notice of the present opinions of the profession as to the pathology of tuberculous diseases generally.

Three distinct theories are still held by respectable portions of the medical profession. Two of these are known as those of Andral and Carswell, the third, of which Dr. Charles J. B. Williams claims to be the author, I shall, for convenience sake, call by his name.

The first two do not differ very materially from each other. Andral considers tubercle as—

> "Nothing else but a secretion of matter which seems to be produced indifferently, either in the last bronchi or in the vesicles which succeed them, or in the cellular tissue interposed between the latter, or in the inter-lobular cellular tissue. This matter, which seems to be primarily liquid, becomes solidified at a period more or less remote from that at which it was secreted, and becomes a tubercle."—*Med. Clinic*, vol. ii. p. 212.
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> "Dr. Carswell considers the tuberculous matter to be a secretion *sui generis* totally destitute of organization, as effete matter, continually separated from blood when this is in an unhealthy state, and thrown out chiefly on the free surface of mucous membranes; and producing bad consequences only in proportion as it accumulates in organs, impedes their functions, and acts on them as foreign matter."—*Williams and Clymer on the Respiratory Organs*, p. 341.

Neither of these views, even if true, would materially advance the state of our knowledge on the subject, as neither of them touch upon the *cause* of the secretion, or the nature of the diathesis in which it occurs; nor does it explain how this effete matter comes to be in the blood. This is the radical defect of Dr. Carswell's theory. My hope is to be able to remedy this defect. The theory of Dr. Williams is much more generally adopted than either of the others, notwithstanding the difficulties many have seen in it, because it is at least definite and tangible.

> "Instead of (with Laennec) classifying tubercle under the vague term of accidental productions, or (with Carswell) as a secretion *sui generis*, I have for many years referred tubercle to a degraded condition of the nutritive material from which old textures are renewed and new ones formed; and that it differs from fibrin or coagulable lymph, not in kind, but in degree of vitality and capacity of organization."

This theory I propose now to analyze, and see if the facts induced in its favour are sufficient to establish it beyond a reasonable doubt, and whether the arguments are all consonant with the well-known principles of physiology.

The symptoms resulting from a *deficiency* of fibrin in the blood are well described by Dr. Williams:—

> "A defect of fibrin causes a tendency to hemorrhages, generally the asthenic kind, and to an unmanageable oozing of blood from any accidental wound or breach of texture. In the same cases, too, wounds do not readily heal nor fractures unite; in fact, the plastic or reparative process is defective, for want of its material, and for similar reasons the nutrition of textures, which consist chiefly of fibrin, such as muscle, is ill-maintained."—*Princ. of Med.*, p. 108-9.

We should suppose, where the material for the plastic or "reparative process" was "degraded," that the nutrition of the textures, which consist chiefly in the deposit of fibrin, would be ill-maintained for want of "capacity of organization" in its material. But the muscles do not suffer pre-eminently, or at least primarily, in phthisis.

What evidence have we that the fibrin in this disease is degraded? Do not "wounds heal and fractures unite," sometimes with great readiness, and always as soon as in other diseases attended with an equal disturbance of the system? Does the surface of wounds ever become coated with a deposit having the remotest resemblance to tubercular matter? Is not the fibrin, which is effused upon them, capable of ready organization? Why is not tubercular matter most frequently deposited in the substance of muscles, or wherever the nutrition is most rapid, the amount of interstitial change greatest, and the calls for efforts at organization most constant and considerable? But this is not the case with the parts in which tubercle is most frequently effused. There is no evidence that the mucous membrane of the bronchial tubes is remarkable for the activity of its nutrition, and the same may be said of the lymphatic glands. In a word, the liability of any organ to tubercular deposits bears no relation to the quantity of fibrin ordinarily required for its nutrition. But is it not plain this would necessarily be the case if a diseased state of the fibrin had anything to do with it? In fact, the fibrous tissues seem rather to possess a positive exemption from the disease:—

> "We have never found tuberculous matter in cartilage, fibrous tissue, serous, synovial, or mucous membranes, tendon, or muscle."—*Carswell's Cyc. of Pract. Med.*, art. TUBERCLE.

Upon what principle of physiology can we conclude that, in a disease affecting in a peculiar manner the sole and entire organizable material of the blood, rendering it unfit for its office, the lungs would be the first part sensibly affected by abortive efforts at nutrition in so very large a proportion of cases? Is it not perfectly plain, that when an entire principle of the blood is affected, the whole body must suffer, and the different parts of it in the precise ratio they make use of that principle? This is the case in chlorosis; and we must admit the possibility of an exception to the laws of nature, before we can allow that it can be otherwise in any disease.

It is true that there is an excess of fibrin in the blood of phthisical patients, in the latter stages, but not until inflammation has been excited by the presence of tubercles. If there were any foreign body—a bullet, for instance—lodged in the lungs, and not encysted, it would excite inflammation, attended by cough, purulent expectoration, &c.; or, as Watson expresses it, "all the symptoms of chronic phthisis," and the fibrin would be found to be augmented in proportion to the extent of the inflammation. But it would not be very philosophical to ascribe the presence of the bullet to the excess of fibrin in the blood, even though we might not know positively how it came there.

There is another reason, which of itself seems conclusive against tubercle being the plastic material in a degraded state. It is that *plastic* lymph is almost always thrown out in immediate connection with tubercular matter. In describing a vomica, Dr. Williams says:—

"The bloodvessels, however, are almost always impermeable in these cases, and the septa are thickened by the *deposition of lymph*, &c."—*Williams and Clymer on Resp. Organs*, p. 329.

Now is it not a fact of physiology, that where lymph is effused in contact with a structure formed of it, that it takes the form of that structure? Is it not contrary to all that is known of pathological process, to suppose that a structure of *lower* vitality could have one of *higher* vitality formed in its midst, and from the very material by which this lower structure is produced; more especially, while the causes of "degradation" are still in full force? If tubercle is lymph, degraded of course, areolar tissue cannot be formed from lymph effused in contact with it; at least, until the causes of degradation are entirely removed. But if it is a *foreign body*, *healthy lymph* may be effused for the purpose of encysting it; and this may be converted into a tissue by which the bloodvessels are closed and the septa thickened.

The lymph corpuscles noticed by Mr. Gulliver in tubercular matter, do not go further towards proving Dr. Williams's theory, than any of the others. Whatever be the nature of tubercle, it is certainly capable of exciting inflammation in the tissues where it is deposited. This inflammation causes an effusion of plastic lymph, for the purpose of encysting the foreign body. But it being soft, liquid, Andral says (Sir Jas. Clark is of the same opinion, *Cyc. Pract. Med.*, art. TUBERCULAR PHTHISIS), and continually augmenting by fresh deposits, the fibrin is mixed with it, its corpuscles separated, and organization prevented; producing precisely the appearance described by Mr. Gulliver.

It now remains to state my own views of the nature of this deposit. It is with the greatest diffidence that I attempt what some of the greatest men who have ever adorned our profession have failed to accomplish, through a long life of patient toil and investigation, devoted to the subject. But they have cleared the way, and but little is left to do now but advance upon the smooth road they have made.

I consider tubercle to be the solid matter of the cutaneous excretion, especially of the sebaceous follicles. This secretion not being expelled by the natural emunctories, is retained in the blood until, in the attempt to eliminate it through an unnatural channel, it is deposited in some other excretory organ, where its fluid matter being absorbed, it becomes a tubercle.

It will be first necessary to show that the secretion of the skin is of sufficient importance to produce this effect when retained.

"It appears," says Dr. Carpenter, "that at least one hundred grains of effete azotized matter are daily thrown off from the skin . . . . When the exhalation of the skin is completely checked by the application of an impermeable varnish, the effect is not, as might be anticipated, an elevation of the temperature of the body; on the contrary, it is lowered, in consequence, it would appear, of the interruption of the aeration of the blood through the skin, which is a function of such importance in the lower animals, and of no trifling account in man. And in a short time a fatal result ensues."—*Elements of Physiology.*

The amount of the cutaneous respiration has never been precisely determined, but it will hardly be doubted that Dr. Carpenter has overrated its importance, when he considers that death takes place from its interruption. Even one whole lung may be rendered impervious, and still life may be preserved; and the fact which settles the question entirely, is, that the body may be immersed in water containing but little air, or even in water from which all the air has been expelled by boiling, and no appreciable inconvenience results, notwithstanding the "aeration of the blood through the skin" is suspended. It is singular that such an every-day experiment should have escaped so acute an observer as Dr. Carpenter.

It is plain, then, that death takes place in these cases, from the retention in the blood of the excrementitious matter ordinarily thrown off by the skin.

Of the amount of the *sebaceous* secretion alone, we can only conjecture, as very little light can be thrown upon it by the ordinary experiments for determining the quantity of the cutaneous secretion. It is not volatile, like the perspiration; it accumulates, and mixes itself with the epidermis; and the diminution of the weight of the body would no more show its amount, than it would that of the urinary secretion still retained in the bladder. But we are in possession of sufficient facts to show that it is very considerable. Any one who has been troubled with a dry, harsh state of the skin of the hands, and has attempted to relieve this by the rubbing on of any oily matter, must have been surprised at the quantity which may be made to penetrate the skin and disappear, before the natural state is restored. But the sebaceous secretion keeps the skin of the whole body constantly in this state. Those, also, who have "dry" hair naturally, and keep it, by the application of oily matter, in the state natural to others, will be able to judge of the quantity requisite to effect this object. When we consider the vast number of the glandulæ of the surface by which the sebaceous matter is eliminated, we shall not doubt their capacity to furnish all that is required, either for the good or bad effects ascribed to it.

The mucous membrane lining the bronchial apparatus and the alimentary canal, is but the inversion of the external tegument of the body, which it resembles in structure, and, to a great extent, in function; so nearly, that in the lowest animals there is no difference whatever between them, except the accident of position. This membrane is lined throughout its extent inwardly as well as outwardly, by numbers of minute glandulæ; those on the external surface being estimated, by Mr. Erasmus Wilson, at not less than seven millions in number. The action of all these glandulæ is depuratory or excretory. The secretion of none of them is destined to be reabsorbed, nor can it be retained in the blood without injury to the system.

No fact in physiology is better ascertained than that when the secretion of any organ, especially an excretory organ, is retained in the blood, an effort is made by some other organ, usually the one most nearly allied to it in function, to eliminate it (*Carpenter's Human Physiology*, p. 608).

Now, if the function of the skin is not properly performed, it is obvious that the mucous membranes will be the first to suffer; that is, if they do not perfectly succeed in supplying, by a vicarious or augmented natural action, the depuration ordinarily effected by the suspended function of the skin. It is from the overwhelming congestion with which they are affected, in the attempt to eliminate the secretion of the skin, that death takes place when the secretion of that organ is completely suspended, as by a varnish, for instance.

Is the function of the skin badly performed in phthisis? Formerly a pearly white skin was considered characteristic of the disease, or rather of the tubercular diathesis. But it is now said that too much stress was laid upon this peculiarity, as the disease very frequently attacks those who do not possess it. But when we look upon the skin as a *gland,* as a great depuratory organ, the retention of the secretion of which in the blood causes death in a few hours, it is hard to conceive that too much attention can be paid to its peculiarities in any disease. I believe all writers still recognize *a peculiarity,* a cognizable anatomical difference of structure from the healthy skin. It seems to be this, that the skin is harsh and dry. Let its texture be fine and white, or coarse and dark, it is uniformly dry and inelastic. It is easily washed clean; dirt does not closely adhere to it. In a word, the *sebaceous secretion is deficient.* I cannot do better than give the description of this peculiarity in the words of Sir James Clark:—

> "The aspect of the countenance generally affords decisive indications of the presence of the affection; in early childhood it has a pale, pasty appearance. If the complexion be dark, the colour of the skin is generally sallow; if fair, it has an unnatural white appearance, *resembling blanched wax* rather than healthy integument. The cutaneous functions are rarely in a healthy state; the skin is either pale, soft, and flaccid, or dry and harsh, and frequently affected with eruptions. Its function of secretion is, in tuberculous subjects, always more or less deranged."—*Cyc. of Pract. Med.*, art. CONSUMPTION.

If, upon examination after death from any disease, the liver, lining membrane of the alimentary canal, or kidneys were found in a state different from the healthy standard, this state would be considered as constituting a prominent feature in the pathology of the disease.

Even if there was nothing in those who inherit the diathesis indicative of a deficient development of the glandulæ of the skin, the causes which produce the disease are sufficient of themselves to point out its true nature. Everything which depresses the action of the skin tends to the production of tubercles. Everything which exalts its function acts as a preventive.

> "Decidedly the strongest of the predisposing causes," says Dr. Wood, "is inheritance;" [congenital malformation of the secretory apparatus of the skin.] "Next perhaps in the degree of influence is cold. Allusion is not here made to the vicissitudes of weather which so frequently occasion attacks of inflammation. Cold may act in this way as an exciting cause; but its most pernicious agency is probably connected with its long-continued application. * * * This fact has been strongly exemplified within my own observation."—*Practice of Medicine,* vol. ii. pp. 104–5.

Could anything be stronger evidence in favour of the idea that the retained secretion of the skin is the cause of tubercular deposits? Is not this as nearly as possible reducing the condition of the subject to that of those who inherit the fatal peculiarity from their parents? All diseases attended by a great disturbance of the function of the skin are notoriously apt to be followed by phthisis. The exanthemata—smallpox, scarlatina, and more especially measles—fevers in which there is much dryness or constriction of the skin—and diabetes, where this reaches the greatest extent, are extremely liable to be followed by consumption.

The evidence deduced from the juvantia is not less strong. The influence of a warm, dry climate is too well known to require it to be dwelt upon. And its influence in developing the glandulæ of the skin, where they are deficient congenitally and in stimulating them where they are depressed or torpid, is equally well known. (See *Carpenter's Elements of Physiology.*) How can a warm climate affect the fibrin of the blood? The hygienic means next in importance, if not superior to the last, is vigorous exercise in the open air:—

> "Vigorous exercise and free exposure to the air are by far the most efficient remedies in pulmonary consumption. It is not, however, that kind of exercise usually prescribed for invalids—an occasional walk or ride in pleasant weather and strict confinement in the intervals—from which much good is to be expected. Daily and long-continued riding on horseback or in carriages over rough roads is perhaps the best mode of exercise; but where this cannot be commanded, unremitting exertion of almost any kind in the open air amounting even to labour will be found highly beneficial."—Dr. Parrish—quoted by Wood, *Practice of Medicine*, vol. ii. p. 111.
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> "They are most fortunate," says Dr. Wood, "who are so situated as to be compelled to exert themselves. It has often been observed that consumptive patients entering the military service have entirely surmounted the disease."
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> "Dr. Guy found that in the close workshops of a printing establishment, the compositors whose employment requires no exertion fall victims to phthisis in the proportion of 44 to 31½ per cent. of the pressmen, who, while breathing the same air, use active bodily exertion. Similar exercise in pure air would have much more salutary effects, the deaths from the same cause in out-door labourers not exceeding 25 per cent."—*Williams's Princ. of Med.*, p. 53.

Can the efficiency of active exercise in the open air be explained in any other way than by its powerfully stimulating effect upon the glandulæ of the skin?

Other means having the same effect are equally lauded:—

> "No remedies of this class have appeared to be so generally useful as counter-irritants of the milder class—*rubefacients extensively* and regularly applied by friction over a large surface of the body."—*Williams's Princ. of Med.*, p. 310.

Does not the difference in the complexion of men and women fully explain the greater liability of the latter to consumption? It is interesting to notice the connection between the habits of the pig—his wallowing in the mire and choking up the pores of the skin, and his great liability to scrofula, to which he has given the name.

Natives of a cold country going to a warm one suffer less from consumption than the natives of the latter; and natives of a warm climate going to a cold one suffer far more. This is true of other animals as well as man. The action of the skin is exalted in the one above its natural standard, and depressed below it in the other.

Is not the thinness of the *alæ nasi*, formerly considered one of the characteristic symptoms of the disease, owing entirely to the want of development of the sebaceous follicles usually so abundant in that situation?

But as to the nature of tubercle itself. Tubercle is evidently a foreign matter in the blood. Even if it is "degraded lymph," it is a foreign matter ~~none the less~~; for ~~dead or dying fibrin~~ has no place in the blood. Besides, all its habits, so to speak, so nearly resemble those of an effete matter retained in the blood, that it seems only to have been the difficulty of telling how it came there, that has prevented *all* from considering it such. It is perfectly evident that it has its origin in the system itself, for it is found under circumstances (as in the fœtus) where its introduction from without is scarcely possible. And whenever the diathesis is acquired, it is through the agency of depressing causes acting upon the general system.

If there has been raised, by the facts I have just mentioned, a presumption in favour of the retained secretion of the skin being the cause of tubercular deposits, this presumption will not be lessened by an examination of the deposits themselves, nor of the rules which seem to govern their distribution.

The sebaceous secretion of the skin has not been analyzed with sufficient accuracy to determine its precise nature: "It is oil, but not oil alone;" and as little is known of the nature of the solid constituents of the other secretions of the skin. It is, therefore, impossible to demonstrate chemically their identity with tuberculous matter. But enough is known to show a very strong probability of this identity.

Tubercle consists for the most part of minute granules, which either consist of, or are very easily converted into, fatty matter.

> "Every gradation may be found between euplastic and aplastic deposits; the cells and fibres which are the representatives of organization,* diminishing in number and completeness, and the material becoming more granular and amorphous, or abounding in fat *globules* in proportion as the deposit is degraded, until in opaque, crude, or yellow tubercle it is altogether aplastic, *consisting of a mere aggregation of granules and fat globules* with mere traces of the remains of cells."—*Williams's Princ. of Med.*, p. 300.

Here at least we see one of the constituents of this secretion in the deposit; and it is the only one that is known with certainty. It is very probable that this constituent of the sebaceous secretion can at any time be detected in the blood of phthisical patients:—

> "The fibrin of the blood presents under the microscope a predominance of granular *matter and fat globules.*"—*Id.*, p. 113.

Is not this a stronger proof of the truth of my theory than the discovery of lymph-corpuscles in the substance of tubercle is of his?

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* I have already shown how these come to be there.

The deposition of fat in the liver, causing what is termed "fatty liver," so common in this disease, may also be regarded as proof that the great fat-secreting gland, the skin, is out of order.

But the evidence afforded by the place and manner of the deposition of this tuberculous matter is stronger still. The sebaceous secretion not being tolerated by the system, an effort is made to free the blood of it; and with Dr. Carswell, I believe this is always done *through the mucous membranes*, or internal *prolongation of the same membrane which should normally excrete it.* If the quantity to be got rid of in this way is small, or the cause obstructing the excretion of the skin be of short duration, no doubt this effort is often successful. There are perhaps but few persons who do not at times void through the mucous surfaces matters which are normally got rid of through the skin without feeling any inconvenience from it. But where the amount to be excreted in this way is considerable, there will always be more or less disturbance of the function of the lungs, kidneys, or alimentary canal.

This may not be considerable, and will soon pass off if the skin resume its office. But if the cause of depression be permanent in its nature, or if, during its action, the secretory power of the mucous membrane be weakened or suspended by inflammation, or any other cause, a deposit takes place.

The reason why the lungs are oftenest the seat of this deposit is very obvious. It may be that the closer analogy between the skin and lungs, than between the skin and any other organ, causes a greater quantity of the secretion to be directed to the bronchial membrane than to any other. But the anatomical structure of the lungs is fully sufficient to account for the frequency of the deposit in them. From all other mucous surfaces, any effused matter would find a ready outlet, by the force of gravity alone, or gravity aided by peristaltic action; but here, gravity, which is the only force acting, unless cough be excited, causes the effused fluid to descend to the air-cells, where it accumulates; its watery parts being absorbed almost as soon as it reaches the cells, we have a tubercle. Here it grows by attracting its like from the blood, as Dr. Williams has well shown. (*Principles of Medicine.*)

This appears far more plausible than Dr. Williams's reasons for the frequency with which the lungs suffer: 1. "Their great vascularity and the large quantity of blood that passes through them, which makes them largely partake of any disorder in the condition of this fluid." If this were the case, they ought equally to suffer in chlorosis and scurvy, or even in rheumatism, for these and many more diseases depend upon a disordered condition of the blood as much as does phthisis. 2. "Their being a chief seat of the formation of fibrin; that principle being more abundant in arterial than in venous blood." Fibrin is more abundant in arterial than in venous blood, probably because before it becomes venous it has to traverse some organ, which takes from it sufficient fibrin for its wants, but gives none to it in return. Dr. Williams has very conclusively shown, in the same work, that fibrin is very rapidly formed in an inflamed part, without the agency of the lungs. 3. "The softness and yielding nature of their texture, which permits effusions to take place more readily than denser textures do." Other effusions seem to take place more readily in areolar tissue. 4. "Their exposure to external causes of disease." The lungs are hardly more exposed to external causes of disease than the alimentary canal, and, laying aside tubercle, are hardly more often diseased.

But the lungs are scarcely ever the seat of a deposit without other organs being affected also. The kidneys are almost invariably implicated; not always, however, by a deposit, for, excepting in the cortical portion of the kidney, the matter has free egress merely by the laws of gravity; but the structure of the gland is often spoiled by its being compelled to eliminate another secretion than its own. The connection of Bright's disease with the scrofulous constitution has been noticed almost as long as the disease itself. This disease we can produce at will, merely by partially obstructing the cutaneous secretion by *varnish* or otherwise; and I am more convinced of the identity of the granular matter in this "degeneration" of the kidney with the granular matter of tubercle, from the identity of the causes producing it, than from all the observations and experiments yet made in relation to it. I consider Bright's disease to be merely an abortive attempt, on the part of the kidneys, to eliminate the sebaceous secretion of the skin, which, instead of being voided, is deposited in their secreting structure; its peculiar appearance being due to that structure. This view receives confirmation from the great increase of oil-globules noticeable in the epithelium-cells of the kidney in this disease, which Dr. George Johnson considers the first pathological change which takes place in Bright's disease.

The albuminuria is, I suppose, caused by the congestion this deposit gives rise to, in the same manner as it would be by congestion from any other cause.

The gastro-intestinal mucous membrane was found healthy by Andral in only one-fifth of the cases examined by him. But it is not to be supposed that it did not excrete tubercular matter, excepting in those cases where signs of disease were apparent after death. It is only when the matter exists in the blood to such an extent that the intestinal follicles are spoiled in the attempt to eliminate it that appreciable lesion can be discovered. And this membrane can no doubt excrete it for a long time, and in considerable quantity, without any such result taking place. Just as in slight biliary obstructions, the colouring matter of bile is exuded from the kidneys, mucous membranes, &c., before it accumulates in sufficient quantity in the blood to be deposited in the textures generally.

There is no one of the mucous surfaces which may not thus excrete tubercular matter. The frequency with which discharges take place from the eyes and ears of scrofulous children is no doubt owing to the elimination by the membranes lining these parts of tuberculous matter. This discharge only requires to have its watery, or, to speak more properly, its *absorbable*[*] parts removed to constitute genuine tubercle.

Andral relates a case in which it is certain that this matter was secreted from the membrane lining the prepuce, in a man having phimosis.

Any disease of one of the mucous surfaces, as inflammation, by diminishing or suspending its excretory power, will throw an additional burden upon the portion which remains sound, besides leading to a deposit in the inflamed part, in consequence of the absorption of the liquid portion during the stagnation of the blood which takes place.

Consumption of the lungs frequently does not manifest itself, in constitutions in which there is an evident predisposition to it, until after an attack of this description.

> "We have often seen cases of pulmonary phthisis commence during convalescence from gastro-enteritis. Before the attack of the intestinal inflammation, the patients had no cough, nor was there any symptom to make one apprehend in them the existence of a pulmonary affection."—*Andral's Medical Clinic, vol. ii. p. 232.*

Inflammation of the lungs themselves is still more apt to be followed by a deposit of tubercular matter than inflammation of any other organ. It acts both by diminishing the excreting power of their mucous membrane, and by inducing a stagnation of the blood, by which the absorption of its watery parts is facilitated. It is in this latter way that the deposit is so often left among false membranes and the other products of inflammation. A deposit having once formed in the lungs, it is easy to see how much more difficult it would be to get rid of it than if it had occurred in the parietes of the alimentary canal, or in any part of the urinary apparatus, excepting perhaps in the cortical structure of the kidney.

In all inflammatory diseases, the calls upon the mucous membranes are greatly increased by the dryness, harshness, and constriction of the skin, denoting partial suppression of its function. This is the case also in fevers, and still more so in the exanthemata, all of which hasten the progress or determine the development of tubercles. The peculiar ill effects of measles is explained by its not only involving the skin, but also the bronchial and alimentary mucous membranes. It is doubtful if any disease affects an equal extent of dermoid tissue, and no one certainly is so apt to be followed, in the predisposed, by phthisis.

The lymphatic glands are said by Louis to be only second to the lungs in the frequency with which they are involved in tubercular disease. I do not believe, however, that they are ever attacked primarily, or, if so, only in those extremely rare cases where the matter abounds in the blood to such an extent that it may be deposited in any tissue, like the colouring matter of bile in jaundice. Their secondary implication is very easily accounted for: inflammation taking place in the membrane from which the effusion is taking place, it is arrested and absorbed by the lymphatic vessels, and carried to the nearest gland, where it is retained like any other foreign matter introduced into these vessels.

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[*] I mean by the *veins*; the entire matter may be absorbed by the lymphatics.

In the lungs, owing to their anatomical structure, the effused matter is presented in a condition favourable for absorption without the agency of inflammation. Hence the frequency with which the bronchial glands are affected with tuberculosis. In some rare cases, all the effused matter is taken up, and the glands alone are found diseased, the lungs being perfectly healthy. (*Andral and Carswell.*)

But though inflammation does not seem to be necessary to induce tuberculosis of the bronchial glands, they are nevertheless much more certainly affected when it does occur. Inflammation seems to increase the activity of the lymphatic system in a remarkable degree.

The mesenteric glands are, I believe, never the seat of tuberculosis excepting in the course of enteric inflammation. This latter may, however, be very slight, and leave no trace of its existence in the dead body, though usually indications of its presence may be detected.

The frequency with which the lymphatic glands of the neck are affected is owing, I believe, to their being the only superficial ones (except those of the groin) whose vessels arise from the surface of mucous membranes.

Inflammation of the gums from teething, a carious tooth, or from any other cause, eruptions around the mouth from gastric irritation, or any inflammation of the conjunctiva or external meatus of the ear, may give rise to absorption of tubercular matter by the lymphatic vessels which are so plentifully distributed upon these parts. The inflammation of a single Meibomian gland will often cause the tumefaction of the glands situated on the side of the neck.

After a deposit has taken place in a gland, there is no need to suppose that it can increase only by the absorption of new matter. As in other situations, tubercle may here attract its own material from the blood, and continue to enlarge, even though the membrane, from which it was originally absorbed, may have resumed its healthy action, or even after it has been completely destroyed, as in the case from Andral, referred to above, where the effusion was upon the prepuce.

This appears to me much more simple than the explanation usually given, that inflammation is excited in a gland, and assumes the tubercular character from the peculiarity of the diathesis.

When suppuration takes place in a scrofulous gland, and it discharges its contents externally, it forms a ready outlet for more of the excretion; its being constantly poured out by the pyogenic membrane which lines the fistulæ which penetrate the gland prevents the occurrence of the healing process. Tubercular affections of the lymphatic glands are much more common in children than in adults, in consequence of the greater activity of their lymphatic systems, or perhaps from the greater frequency with which their mucous membranes are inflamed. There are cases where the matter of tubercle is effused upon other tissues than the mucous, but always in those in which pus or other morbid products are usually deposited, as the brain, intermuscular cellular tissue, &c. These cases only go to prove that tubercle is a foreign matter deposited from the blood, but throw no light on its nature.

It is hardly necessary to state that my only aim in this essay is to direct the attention of the profession to the view I have advanced of the pathology of tubercular deposits, and not as a complete treatise on the subject. I have thrown together the most prominent features of what I believe to be the true pathology of tuberculosis, leaving it to others to accumulate the evidence calculated to establish or disprove its truth, and to apply it to the explanation of all the leading phenomena connected with, or arising out of the deposit of tubercular matter in the several tissues and organs of the body.

I think I have shown that the nature and importance of the secretion of the skin are sufficient to give rise by its deficiency of suspension to the accumulation of tuberculous matter in the blood; that in those individuals in whom consumption is hereditary, there is often a congenital deficiency of the sebaceous follicles; that the disease can at any time be produced or aggravated by causes which depress their action; and prevented or relieved by causes which exalt it; that the only well-ascertained product of the secretory action of these follicles is found in large amount in tubercle; and that it is deposited in precisely such situations as we would be led to suppose, upon general principles of physiology, that the retained secretions of the skin would be.

This theory has at least the merit of being consistent with all the phenomena of the disease; of explaining the action of the causes which produce it upon established physiological principles; of explaining its hereditary transmission by the same law which causes children to resemble their parents; of redeeming our practice from empiricism, and making it rational, and most important of all, of *explaining* the efficiency of hygienic means, and thus impressing the necessity of them more effectually than any amount of mere recommendation could do, even though this were founded upon the largest experience. It differs from the views of Andral and Carswell, by showing the nature and source of the "peculiar secretion," of which they speak; and seems, upon the whole, far more simple and definite than any other yet advanced.

WHITEVILLE, *Columbus County, North Carolina,*
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ART. X.—*Phosphate of Lime in Phthisis.* By S. KNEELAND, Jr., M. D. Read before the Boston Society for Medical Improvement, April 26, 1852.

THE great number of remedies which have been recommended, tried, and found wanting in the treatment of phthisis, justifies the medical world in looking with distrust upon any new article which may be advanced as possessing power against this fatal disease; but, while we are incredulous, we may also be hasty and unjust to condemn, before a careful examination and a systematic trial have enabled us to judge knowingly in the matter.

Without pretending that the phosphate of lime is of any advantage in the treatment of phthisis, it seems to me that there are chemical and physiological reasons why it may be beneficial in this disease; at any rate, there is a singular coincidence, to say the least, between this remedy and the product which has been generally considered as nature's attempt to cure by a chemical transformation of tubercle.

Both albumen and fibrin, the chief original components of the tissues, contain about two per cent. of phosphate of lime; liquid albumen dissolves this salt, which may be separated from it in its coagulated state; so fibrin, when burned, leaves a portion of this salt. It is generally agreed by physiologists that the deposition of tubercular matter is a perverted or abnormal form of the process of nutrition, so that albuminous tubercle is deposited in the tissues instead of the latter being replaced by organizable fibrin. Now, though this conversion of albumen into fibrin, necessary for normal nutrition, may be more of a *vital* than a *chemical* process, and though albumen and fibrin have the same chemical constitution, and, so far as we know, the same proportion of phosphate of lime, still this salt may have an important influence on the form which the tubercle may assume. From an essay in the *London Lancet*, on the "Physiology and Pathology of the Phosphate of Lime," it appears that this salt exerts a singular influence over the formation of cells; and hence it was recommended and used with success in many depraved conditions of the system; keeping up a normal nutrition and counteracting emaciation. This is in accord with the condition of the blood in phthisis, which, according to Andral and Gavarret, though it may be rich in fibrin, is deficient in plasticity, forming what is called *cacoplastic* or *aplastic* tubercle, according to the presence or absence of organization in this product. By the above terms are expressed the two great forms of tubercle, viz.: 1, the "semi-transparent, miliary, gray, and tough yellow forms," in which there are distinct traces of organization in the form of cells and fibres; which, however, never reach any higher organization; hence termed cacoplastic. 2. The "opaque, crude, yellow" tubercle, which is absolutely structureless, resembling a granular albuminous coagulum; hence called aplastic. The former has a tendency to contract, the latter to soften. If, then, this influence of phosphate of lime over cell-growth be established, it does not seem unreasonable to connect the different degrees of the plasticity of the blood, and the different degrees of the organization of tubercle, with the variable amount of this salt in the circulating fluid. I am not aware that any chemical analyses have been made to determine this point; though the difference might be too minute to be detected by the minutest investigations at present practicable.

There is another point of view from which it is interesting to examine phosphate of lime in connection with tubercle; that is, in connection with the cicatrices and calcareous formations so often found in phthisis, and usually recognized as an attempt at cure on the part of Nature.

Laënnec long since expressed the opinion that tubercular disease may be arrested in its second stage by transformation into calcareous matter, or by cicatrization. The fact of these concretions cannot be denied; M. Roger found them in the lungs of old people, fifty-one times in one hundred, in subjects taken at random. The same author (*Archiv. Gén. de Méd.*, 1839) shows the passage from one to the other, from tubercle to a chalky concretion, and from this last to a calcareous mass; and, what he considers remarkable, the transformation begins at the centre. M. Valleix has seen the three stages, in concentric layers, in the same tubercle; a calcareous centre, a cretaceous layer outside of this, and a layer of crude tubercle externally.

The chemical analysis of crude unorganized tubercle is: animal matter 98 parts in 100; muriate of soda, .15; phosphate and carbonate of lime, 1.85; and traces of oxide of iron. In the concretions the chemical elements are the same as in tubercle, but their proportions are very different; while tubercle has 98 parts in 100 of animal matter, the concretions have only 5; the latter are principally made up of *phosphate of lime*, while tubercle has only two per cent. of it, like albumen and fibrin. This looks very much like a calcareous impregnation of tubercle, or a chemical transformation from an excessive deposit of phosphate of lime; and this without the softening and discharge of the tuberculous matter.

The cicatrices, seen often at the summit of the lungs, were also considered, even by Laënnec, as efforts of nature to heal the excavations in the lungs by depositing in excess the phosphate of lime necessary for the formation of the cartilage of which the cicatrices of the lungs are usually formed. At any rate, we find cicatrices of caverns at the summit of the lungs, after the discharge of the softened tubercle. The lining false membrane becomes more and more cartilaginous, the walls are brought into contact, forming a fibro-cartilaginous fistula or hollow cicatrix, which may or may not contain concretions of phosphate of lime; though, if permeable to the air through any bronchial tube (of which the openings into the cavities are usually obliterated), we should expect to find this salt, which is almost always present in the fluids of sinuses and fistulæ communicating externally. According to Louis, these cicatrices are a rare and happy termination of tubercular cavities.

Many cases are on record of individuals having recovered after having presented unequivocal signs of phthisis, and who, dying years afterwards of another disease, have presented these calcareous concretions at the summit of the lungs. In view of such cases, it was asked by Andral, many years since, "Is it not possible that, the calcareous phosphate having become predominant, the secretion of tubercle may be arrested?" As it were, extinguished?

As almost all the cases of cicatrization and calcareous transformation have been found in old persons in whom tubercles are rare and few in number, it may be objected, with Louis, that there is no proof that these few tubercles, of which we find the traces and alterations, were not developed at an advanced age, when the vital power of the organs is diminished, and when such deposits are common in other parts of the system; making phthisis, as far as these facts go, curable only at the age when it is least common and least to be feared. It may be answered that these pulmonary concretions are different from the ossifications common in old people; they present no traces of a fibrous character, as do the latter; they also contain only five per cent. of animal matter, while the latter contain thirty-five per cent.

We find, then, phosphate of lime, so essential to vegetable life, playing a very important part in the production of animal-cells, and in this way influencing the amount of organization in tuberculous growths; we find it in the cicatrices of pulmonary caverns—and especially we find it in the concretions, which are acknowledged to be transformed tubercle, nature's successful attempt at the cure of phthisis. We hence naturally inquire, cannot medical art transform a tubercle, and cicatrize a cavity?

Allusion may be made here to an interesting case of resolution of tubercle under the use of cod-liver oil, reported by Dr. Chas. E. Ware, to the Society, Aug. 25, 1851, and published in its "Extracts," p. 171. In this case, which proved fatal from disease of the bladder, there were found in the upper lobes of both lungs, "numerous cretaceous masses, some of them quite large, with the substance of the lung contracted and hard about them; no crude tubercles or cavities." The patient was exceedingly reduced, and continued the use of the oil for "four months, all the time failing, before she began to experience any benefit."

This patient was only thirty-five years of age, showing that these cretaceous masses may, and doubtless often do, occur in other than old people. He alludes to three other young women, in whom there was hardly a doubt as to the existence of tubercle, who took the oil for nearly as long a time, and with great improvement.

In this case, cod-liver oil was used, and not phosphate of lime; but cod-liver oil contains phosphorus in larger proportion than it does iodine, to which last substance the efficacy of the oil was formerly supposed to be due; this phosphorus, meeting lime in the system, may thus have been instrumental in transforming the tubercles. How much of the cerebral and urinary trouble may have been caused by this minute portion of phosphorus, long continued, may be worthy of consideration, especially if the well-known action of this substance on the nervous and genito-urinary system be remembered; and if similar symptoms should be observed in other cases of the administration of the cod-liver oil, or the phosphate of lime, singly or combined.

Of the influence of cod-liver oil, in causing a deposition of phosphate of lime in the system, we have ample evidence from its effects in rickets; indeed, it was from its good effects in this disease that the medical profession adopted it from the Baltic fishermen, about 1824. In rickets, there is a deficiency of phosphate of lime in the bones to such an extent often that they may be bent almost like wax, as many have seen in the wards of M. Trousseau; the use of the oil for a few weeks acts like magic in giving solidity to the bones by the deposition of the required phosphate of lime; and this we think it can only effect by the phosphorus it contains.

The case of Dr. Ware's would also point to a long-continued use of the phosphate of lime, before deciding on its uselessness; his patient used the oil four months before she perceived any benefit from it.

For the reason that the *carbonate* of lime enters into the composition of these concretions; and, from Valleix's statement above alluded to, possibly forms the first and transitory stage of transformation into the phosphate, this salt may also be of use; it would seem that the carbonic is replaced by phosphoric acid in the completely transformed tubercle; if the transformation even into the carbonate of lime, supposing this anterior to the deposition of the phosphate, could be in any way favoured, a great point would seem to be gained in the aplastic tubercle. And, if the phosphate can add to the organization of tubercle, by increased cell-growth, and thus favour contraction and cicatrization (of which as yet we have not sufficient data to judge), we have certainly great cause for hope.

It really seems that a careful examination and systematic trial, in the direction to which the attention of the profession is now turned, promise to reveal important facts, if not to discover how to prevent and even to cure this frightful disease. We know, possibly, *what* we want, and that is *phosphate of lime;* but we do not know how to get this substance exactly *where we want it.* Phosphate of lime, being insoluble in water, and very slightly soluble in liquid albumen, may very likely not be the form, however pure and fine it may be, in which it can best be introduced into the system; it may be better to separate its elements and give the phosphorus with or without lime, or phosphate of lime with cod-liver oil; or it may be better to obtain its introduction by the decomposition of other salts. Questions like these, and the effects it may have on the nervous, osseous, and vascular systems, on the urinary and other secretions, &c. &c., can only be determined by future investigations, perseveringly made.

BOSTON, *May* 1852.